Claims

1. A process of recovering arabinose and optionally at least one other monosaccharide selected from the group consisting of galactose, rhamnose and mannose from vegetable fiber rich in heteropolymeric arabinose, wherein the process comprises the following steps:

(a) controlled hydrolysis of said vegetable fiber in an aqueous solution to produce an aqueous hydrolyzate containing arabinose, at least one other monosaccharide selected from the group consisting of galactose, rhamnose and mannose, and optionally poly-, oligo- and/or disaccharides,

(b) optional neutralization of said aqueous hydrolyzate,

followed by at least one of the following steps (c) and (d):

(c) fractionation of said aqueous hydrolyzate to obtain a fraction enriched in arabinose, at least one other fraction selected from the group consisting of a fraction enriched in galactose, a fraction enriched in rhamnose and a fraction enriched in mannose, and optionally one or more fractions enriched in poly-, oligo- and/or disaccharides, followed by the recovery of said fraction enriched in arabinose and optionally one or more of said other fractions, and

(d) crystallization of arabinose.

2. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose contains more than 15% arabinose on DS.

3. A process as claimed in claim 2, wherein said vegetable fiber contains more than 35% arabinose on DS.

4. A process as claimed in claim 2, wherein said vegetable fiber rich in heteropolymeric arabinose is an exudate gum.

5. A process as claimed in claim 4, wherein said exudate gum is selected from gum arabic, gum ghatti and gum tragacanth.

6. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose is sugar beet pulp.

7. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose is selected from hardwood bark, grain straw and hulls, corn husks, corn cobs, corn fibers and bagasse.

8. A process as claimed in claim 7, wherein said hardwood bark is selected from beech bark and birch bark.

9. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose is water-soluble vegetable fiber.

10. A process as claimed in claim 1, wherein said hydrolysis is carried out as a selective hydrolysis by adjusting the hydrolysis conditions so that more than 50% of said heteropolymeric arabinose is hydrolyzed into monomeric arabinose.

11. A process as claimed in claim 10, wherein more than 70% of said heteropolymeric arabinose is hydrolyzed into monomeric arabinose.

12. A process as claimed in claim 11, wherein more than 80% of said vegetable fiber is hydrolyzed into monomeric arabinose.

13. A process as claimed in claim 1 , wherein said hydrolysis is carried out as a selective hydrolysis by adjusting the hydrolysis conditions so as to obtain a hydrolyzate where the content of arabinose is more than 10% on DS.

14. A process as claimed in claim 13, wherein the content of arabinose is more than 15% on DS.

15. A process as claimed in claim 14, wherein the content of arabinose is more than 20% on DS.

16. A process as claimed in claim 1, wherein said hydrolysis is carried out as a selective hydrolysis by adjusting the hydrolysis conditions so as to obtain a hydrolyzate where the content of galactose is less than 10% on DS.

17. A process as claimed in claim 16, wherein the content of galactose is less than 5% on DS.

18. A process as claimed in claim 17, wherein the content of galactose is less than 2% on DS.

19. A process as claimed in claim 1, wherein said hydrolysis is carried out with an acid selected from mineral acids and organic acids.

20. A process as claimed in claim 19, wherein said inorganic acid is sulphuric acid.

21. A process as claimed in claim 19, wherein said hydrolysis is carried out at a temperature in the range of 70 to 140°C, at a pH in the range of 0.7 to 2.5 and the hydrolysis is continued for 0.4 to 6 hours.

22. A process as claimed in claim 1, wherein said fractionation is carried out by chromatographic fractionation to obtain a fraction enriched in arabinose, at least one other fraction selected from a fraction enriched in galactose, a fraction enriched in rhamnose and a fraction enriched in mannose, and optionally one or more fractions enriched in poly-, oligo- and/or disaccharides.

23. A process as claimed in claim 22, wherein said chromatographic fractionation is carried out using a column packing material selected from cation exchange resins.

24. A process as claimed in claim 23, wherein said cation exchange resins are selected from strongly acid cation exchange resins.

25. A process as claimed in claim 24, wherein the ion form of said strongly acid cation exchange resin is selected from H^+, Na^+, Ca^{2+}, Al^{3+}, Sr^{3+} and Ba^{2+}.

26. A process as claimed in claim 23, wherein said cation exchange resins are selected from weakly acid cation exchange resins.

27. A process as claimed in claim 26, wherein the ion form of said weakly acid cation exchange resins is selected from H^+, Na^+ and Ca^{2+}.

28. A process as claimed in claim 22, wherein said chromatographic fractionation is carried out using a column packing material selected from anion exchange resins.

29. A process as claimed in claim 28, wherein said anion exchange resins are selected from weakly basic anion exchange resins.

30. A process as claimed in claim 28, wherein said anion exchange resins are selected from strongly basic anion exchange resins.

31. A process as claimed in claim 30, wherein the ion form of said strongly basic anion exchange resin is selected from HSO_3^- and SO_4^{2-}.

32. A process as claimed in claim 1, wherein said fractionation is carried out by membrane filtration.

33. A process as claimed in claim 32, wherein said membrane filtration is carried out by nanofiltration to obtain a fraction enriched in arabinose as the nanofiltration permeate and a fraction enriched in poly-, oligo- and/or disaccharides as the nanofiltration retentate.

34. A process as claimed in claim 1, wherein the process comprises at least two fractionations selected from chromatographic fractionation and/or membrane filtration.

35. A process as claimed in claim 1, wherein said fraction enriched in poly-. oligo- and/or disaccharides is further subjected to hydrolysis to obtain a hydrolyzate containing galactose and optionally rhamnose, mannose and additional arabinose.

36. A process as claimed in claim 35, wherein the process further comprises separating galactose and optionally rhamnose, mannose and additional arabinose from said hydrolyzate.

37. A process as claimed in claim 1, wherein said crystallization of arabinose is carried out from said hydrolyzate.

38. A process as claimed in claim 1, wherein said crystallization of arabinose is carried out from said fraction enriched in arabinose.

39. A process as claimed in claim 1, wherein said crystallization of arabinose comprises boiling and cooling crystallization.

40. A process as claimed in claim 39, wherein said crystallization of arabinose is carried out from a solution having an arabinose purity of more than 65% on DS.

41. A process as claimed in claim 1, wherein said crystallization of arabinose comprises cooling crystallization.

42. A process as claimed in claim 1, wherein said crystallization of arabinose comprises boiling crystallization.

43. A process as claimed in claim 41, wherein said crystallization of arabinose is carried out from a solution having an arabinose purity of more than 70% on DS.

44. A process as claimed in claim 1, wherein said crystallization of arabinose is carried out in the presence of less than 10% galactose on DS as an impurity.

45. A process as claimed in claim 44, wherein said crystallization of arabinose is carried out in the presence of less than 5% galactose on DS as an impurity.

46. A process as claimed in claim 45, wherein said crystallization is carried out in the presence of less than 2% galactose as an impurity.

47. A process for the crystallization of arabinose from a biomass-derived solution, wherein said crystallization comprises boiling crystallization.

48. A process as claimed in claim 47, wherein said crystallization of arabinose is carried out from a solution having an arabinose purity of more than 65% on DS.

49. A process as claimed in claim 48, wherein said crystallization is carried out in the presence of less than 10% galactose on DS as an impurity.

50. A process as claimed in claim 49, wherein said crystallization is carried out in the presence of less than 5% galactose on DS as an impurity.

51. A process as claimed in claim 50, wherein said crystallization is carried out in the presence of less than 2% galactose on DS as an impurity.

52. A process as claimed in claim 1 or 47, wherein said crystallization is carried out in water.

53. A process as claimed in claim 1 or 47, wherein said crystallization further comprises washing of the arabinose crystals.

54. A process as claimed in claim 37 or 47, wherein said crystallization provides a crystalline arabinose product having a purity of more than 60% on DS.

55. A process as claimed in claim 54, wherein the purity of the arabinose product is more than 70% on DS.

56. A process as claimed in claim 55, wherein the purity of the arabinose product is more than 90% on DS.

57. A process as claimed in claim 56, wherein the purity of the arabinose product is more than 98% on DS.

58. A process as claimed in claim 38 or 47, wherein said crystallization of arabinose provides crystalline arabinose having a purity of more than 98% on DS.

59. A process as claimed in claim 58, wherein the purity of crystalline arabinose is more than 99% on DS.

60. A process as claimed in claim 59, wherein the purity of crystalline arabinose is more than 99.5% on DS.

61. A process as claimed in claim 1, wherein the process comprises a further step of subjecting crystallized arabinose or said fraction enriched in arabinose to epimerization to convert arabinose to ribose.

62. A process as claimed in claim 1, wherein said arabinose is L-arabinose.

63. Crystalline L-arabinose, which is obtainable by a process as claimed in any one of claims 1 to 62.

64. Crystalline L-arabinose based on vegetable fiber.

65. Crystalline L-arabinose as claimed in claim 64, which has a melting point higher than 163°C, determined by DSC with a heating rate of 10 °C/min.

66. Crystalline L-arabinose as claimed in claim 65, which has a melting point higher than 158°C, determined by the European Pharmacopeia method.

67. Crystalline L-arabinose as claimed in claim 64, which has a purity of more than 98%.

68. Crystalline L-arabinose as claimed in claim 64, which has a purity of more than 99%.

69. Crystalline L-arabinose as claimed in claim 64, which contains galactose in an amount of less than 0.5% on DS.

70. Crystalline L-arabinose as claimed in claim 69, which contains galactose in an amount of less than 0.2% on DS.

71. Crystalline L-arabinose as claimed in claim 64, which is obtainable by boiling and cooling crystallization of arabinose.

72. Crystalline L-arabinose based on vegetable fiber, which has a melting point higher than 163°C, determined by DSC with a heating rate of 10 °C/min, a melting point higher than 158°C, determined by the European Pharmacopeia method, a purity of more than 99%, and a galactose content of less than 0.5% on DS and which is obtainable by boiling and cooling crystallization of arabinose.

73. Use of the crystalline L-arabinose of any one of claims 64 to 72 in pharmaceuticals and foodstuffs.

74. Use as claimed in claim 73, wherein the foodstuffs are selected from diet foodstuffs and diabetic foodstuffs.